



# Petroleum Refinery Benchmarking Concepts

Cap and Trade Allocations and Benchmarking Workshop

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## The value of benchmarking.

- Repeated studies show that 80% of car drivers believe that they are “better than average” drivers.
- Benchmarking provides externally grounded data to prove what’s good...what’s average...what’s bad.
- The petroleum refining industry has participated in broad benchmarking initiatives over the past 25+ years.

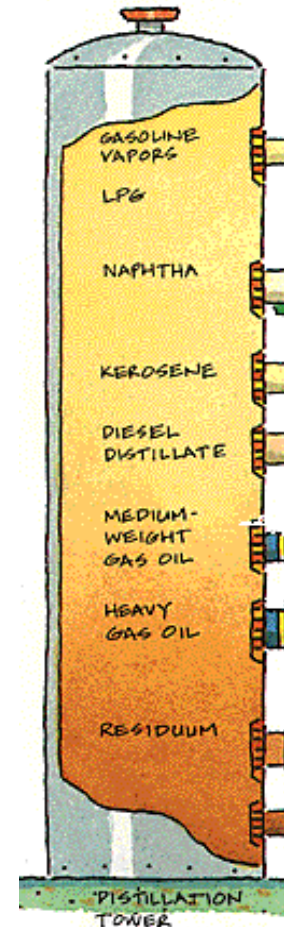
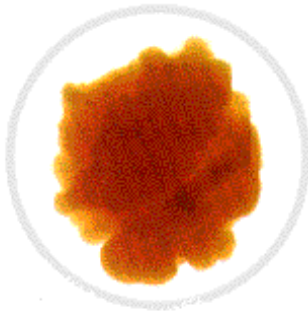
## Complex refining processing needs to be accounted for.

- “Production”, as measured by inputs or outputs, is not an adequate performance measure for petroleum refineries.
- “Complexity” – the ability to produce a high yield of clean fuels from a range of crude types – has to be taken into account.

## Why complexity?

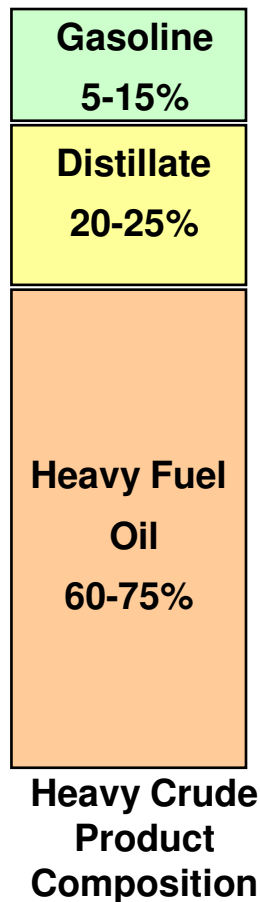
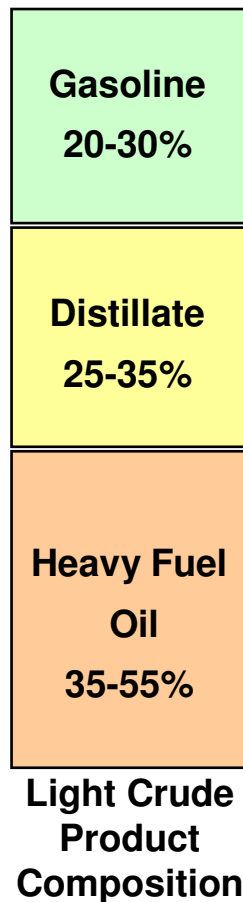
- No two refineries are alike
  - Each was designed with a combination of technologies:
    - to suit the perceived market opportunities
    - feed availabilities
    - adapt to an ever-changing market place
    - owner financial capability
    - new environmental realities.
- Crude quality is declining = more processing.
- Products are getting cleaner = more processing.
- There is a range of refining capability out there.

# Separation

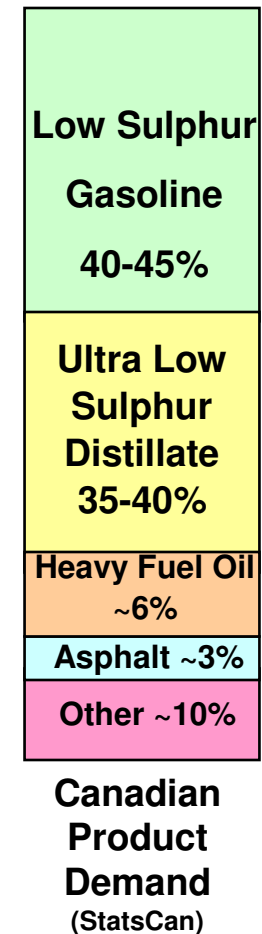


- Fractions of the crude boil at different temperatures.
- Components are separated by distillation and drawn off as they condense.
- Distillation is found in every process area.
- May be at high pressure, low pressure or under a vacuum.

# Crude types vs. Demand



- Naturally occurring hydrocarbon molecules do not meet customer needs.
- The refining processes must adjust the molecules, reshape them and remove contaminants to ensure they meet requirements for:
  - end-use performance
  - environmental performance.

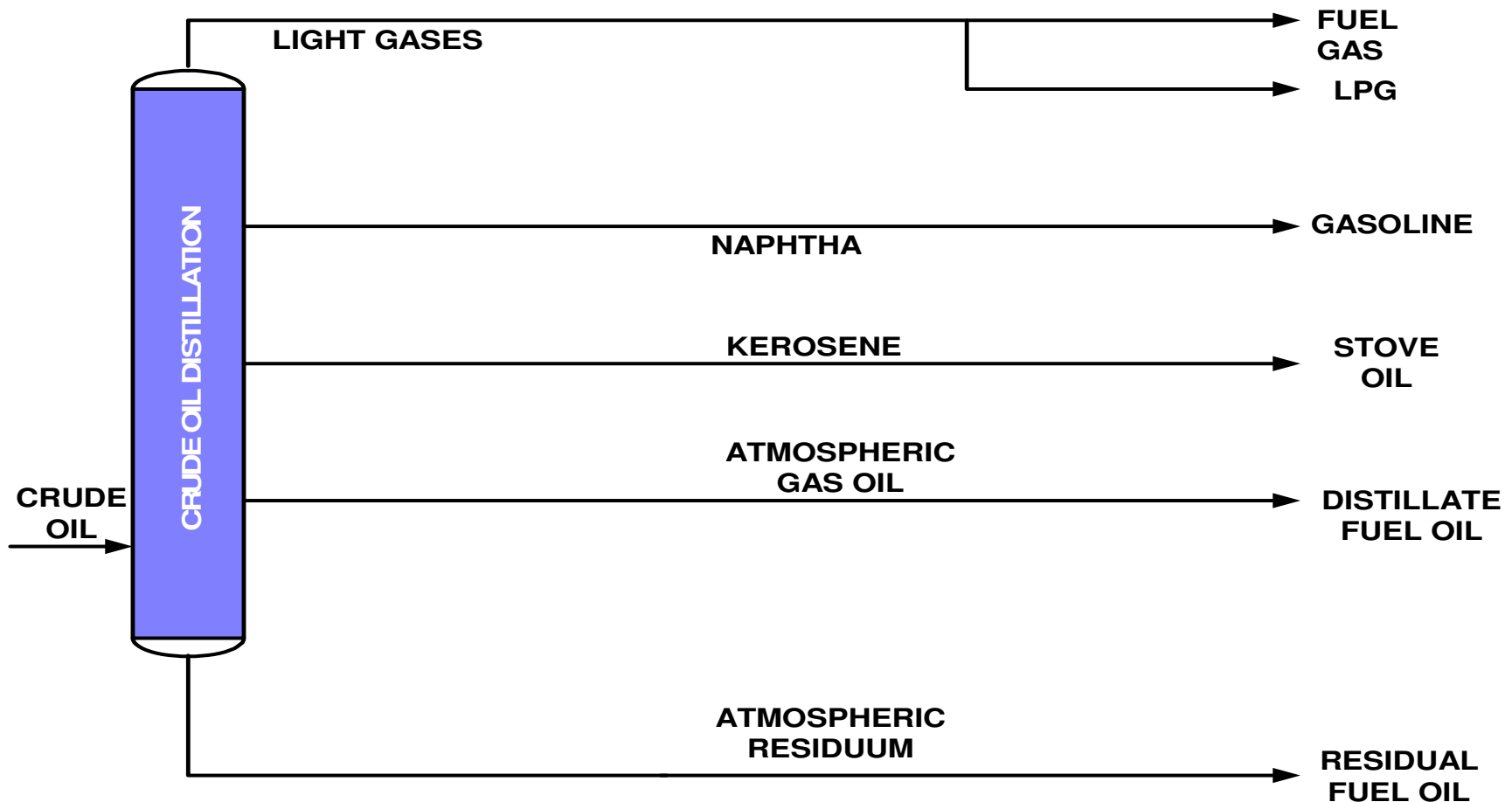


# Conversion

- Upgrading Separation products by changing their chemical structure.
- Processes mainly use high temperature, Hydrogen and a catalyst Pt/Co/Ni.
- Reforming, Cracking (FCCU and Hydrocracking), Alkylation, Isomerization, Polymerization, some Coking processes.
- Delayed Coking is also a conversion process but does not use a catalyst or Hydrogen.

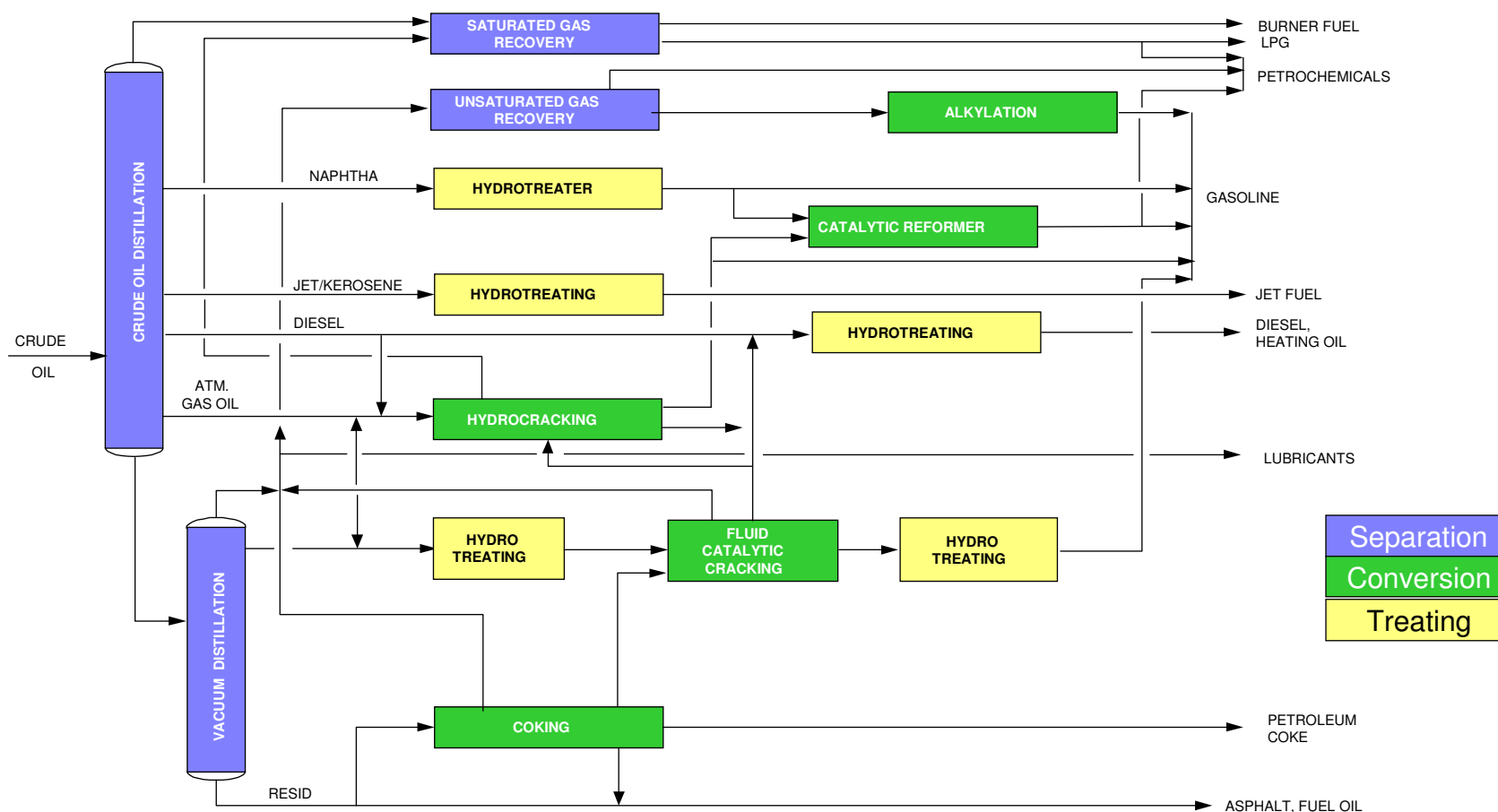


# First generation petroleum refineries were simple separation processes.





# Modern refineries produce clean fuels through intensive processing.

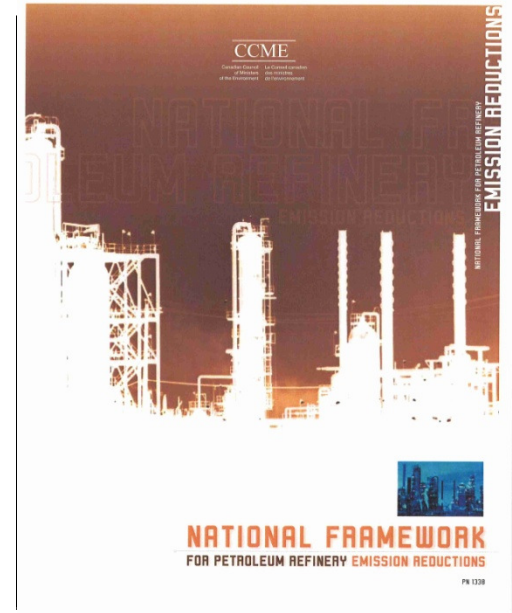


## Solomon benchmarking is unique to the petroleum refining industry.

- Refining benchmarking concept developed by Solomon Associates Inc.
  - over the last 20+ years
  - involving a massive database: 300 refineries world-wide.
- From this, the Canadian Petroleum Products Institute (CPPI) has worked with Environment Canada to develop a complexity measure called Refinery Activity Index (RAI).
- Industry is reporting on this basis to Alberta Environment.
- Complexity measures continue to evolve as “Complexity Weighted Barrel ” (CWB) is being studied by the industry and may have a stronger correlation to GHGs than RAI.

## CPPI has also worked on benchmarking for air pollutants.

- National Framework Petroleum Refinery Emissions Reduction (NFPRED) developed under the CCME umbrella.
- Started in 2001 as a 'new approach to reduce emissions.
- Developed through a unique Multi-stakeholder approach.
- Alberta and Environment Canada co-chaired a Steering Committee of Federal, Provincial and Municipal Agencies, Environmental and Health NGOs, CPPI.
- Developed to help jurisdictions establish facility-wide emissions caps.
- Core of approach is to achieve similar performance to US (confirmed to be the most stringent globally), but with greater flexibility on how to achieve those levels thus preserving competitiveness.
- Published in 2005 and lauded by former Environment Canada DM as an example of «smart regulation».



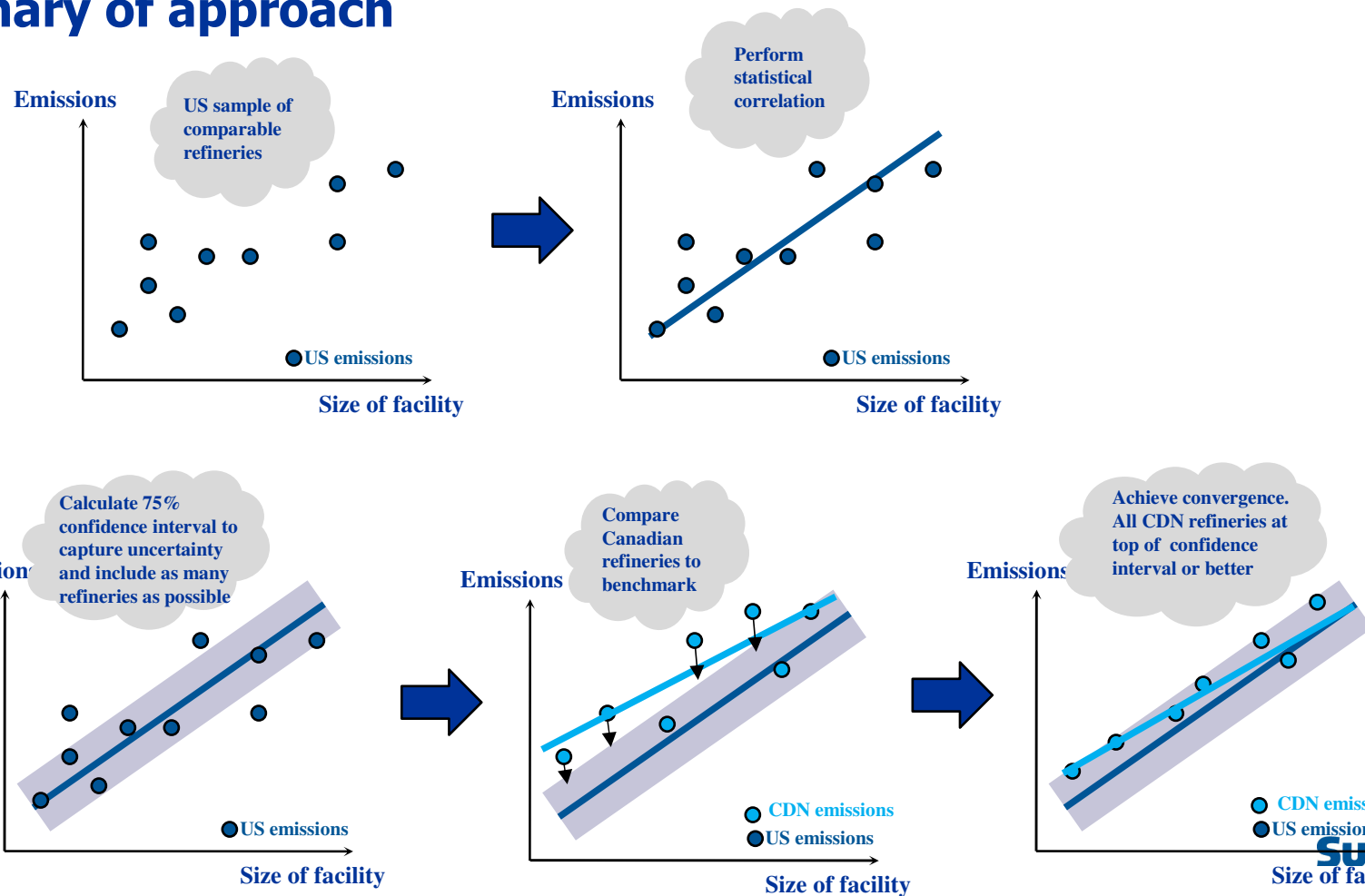
# National Framework Petroleum Refinery Emissions Reduction (NFPRER)

## Key principles & expected outcomes

- Preserve competitiveness of the petroleum refining sector in Canada.
- «Performance» based approach where each refinery is independently treated rather than 'prescriptive' approach.
- Maintain any superior performance that already exists in Canada.
- Facility wide caps on emissions to allow flexibility consistent with emissions trading.
- Convergence of the environmental performance (current and anticipated) of Canadian refineries with comparable U.S. refineries.
- Continuous improvement of environmental performance in a prioritized and phased manner over a ten-year implementation and update strategy.

# National Framework Petroleum Refinery Emissions Reduction (NFPRER)

## Summary of approach



# National Framework Petroleum Refinery Emissions Reduction (NFPRER)

- Benchmarking is central to the objective of convergence with comparable US refinery performance.
- Benchmarking CDN refineries with respective peer US group is feasible and credible but imperfect.
- Correlation do have uncertainty and confidence intervals recognize the imperfections and scatter in the data.
- 75% confidence intervals reflect the statistical uncertainty associated with:
  - Reporting accuracy in historical US/CDN data (has improved over time)
  - Varying reporting methodology
  - Emissions reduction projections variability
  - Feedstock, processes and operation variability
- Confidence intervals also addresses the issue of correlation fit ( $R^2$ ) of the regressions.

## **Petroleum industry is experienced with benchmarking.**

- Benchmarking is a valuable tool to measure industry and facility performance.
- Large database of refineries world wide lends credibility and practicality to the concept.
- Benchmarking is necessary for establishing appropriate targets.

